Wokingham Borough Council Local Plan Update

Renewable Energy Provision Statement

On behalf of **Wokingham Borough Council**

Project Ref: 332110523 | Rev: V2 | Date: November 2021

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Document Control Sheet

Project Name: **Wokingham Borough Council Local Plan Update**

Project Ref: **332110523**

Report Title: **Renewable Energy Provision Statement**

Doc Ref: **V1**

Date: **November 2021**

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Revision	Date	Description	Prepared	Reviewed	Approved
1	01/06/21	Draft	FP	JG	JR
2	05/11/21	V1 – Final version	FP	JR	JR
3	17/11/21	V2 – Final version	FP	JR	JR

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1 Introduction

1.1 Background

1.1.1 Wokingham Borough Council (WBC) is in the process of reviewing and updating their local planning policies through the preparation of a new local plan – known as the Local Plan Update (LPU).

1.1.2 Stantec was appointed to support the plan-making and preparation of the new Local Plan through the provision of consultancy services.

1.1.3 This report provides energy-related information to inform the opportunities that exist for potential renewable and low carbon energy within two of the larger and more complex sites under consideration through the LPU process. Site specific evidence to support renewable energy mapping has been prepared to support the strategic masterplan options.

1.1.4 There are two areas of land for potential strategic scale development that require further consideration through the LPU, and for which consultancy support is considered necessary. The sites are:

1) Hall Farm & Four Valleys; and

2) South Wokingham Strategic Development Location (SDL) extension.

1.2 Approach and Aims

1.2.1 This report aims to provide an evidence base that will inform the emerging LPU, by identifying energy-related opportunities within the two sites of focus.

1.2.2 This assessment has:

- Reviewed energy-related policies at regional level to inform renewable energy opportunities;
- Reviewed commercially available renewable energy technologies by considering their feasibility within the context of the two focus development site areas;
- Undertaken an energy opportunities and constraints exercise for each site, mapping suitable locations for renewable energy, such as solar PV, within the wider masterplan, in line with the compatibility of other land use requirements;
- Reviewed existing power grid infrastructure capacity to accommodate future growth;
- Explored heat network opportunities by understanding where low and zero carbon energy would be most viable within the sites and which of these strategic developments can most effectively support district heat capacity; and
- Provided recommendations for how the energy opportunities can be appropriately incorporated as far as possible into the wider masterplan options for each site.

1.2.3 This report will cover the following structure:

- Section 2: Areas of Strategic Scale (Sites);
- Section 3: Policy Context;
- Section 4: Renewable Energy Screening;

- Section 5: Heat Networks Opportunities;
- Section 6: Utilities and Grid Infrastructure; and
- Section 7: Conclusions and Recommendations.

2 Areas of Strategic Scale Development (Sites)

2.1 Hall Farm & Four Valleys

2.1.1 Hall Farm and Four Valleys site comprises of a significant expanse of open countryside largely owned by the University of Reading (UoR) to the south of the M4, straddling the Loddon River valley to the east of Shinfield. The site consists of relatively flat land used largely for agricultural purposes.

2.1.2 The eastern half of the site is characterised by archaeological sites, Public Rights of Way (PRoW) and listed buildings that may be sensitive to several renewable energy technologies. This is further discussed in Section 5.

2.1.3 The western half of the site is characterised by Berkshire Biodiversity opportunity area and a proposed Valued Landscape area. Local wildlife sites can be found along the River Loddon running through the middle of the site. The area of Biodiversity Interest may have implications on feasibility of implementing renewable and zero carbon technologies. This is further discussed in Section 5.

2.1.4 Large areas of the site lie within Flood Zone 2 due to the presence of the River Loddon running through the middle of the site. WBC are currently exploring the potential for a flood/climate change alleviation scheme for the River Loddon immediately to the south M4 motorway which would reduce flooding at Showcase roundabout. This would potentially result in an increased permanent body of water that may provide significant amenity benefits and opportunities to create new ecological habitat.

2.1.5 The University of Reading (UoR) are currently proposing significant employment related development in the western part of the site, in the form of a Royal Berkshire Innovation Park proposal (the 'Four Valleys' proposals). The vision is based on themed employment sectors that would cater to the film/media, technology, health, and heritage/ arts industries. The proposal would incorporate the current Thames Valley Science Park near Shinfield and take in additional land to the south and west. This is anticipated to have energy implications and has been considered within this report.

2.1.6 Approximately 4,500 residential units could come forward within Hall Farm site.

2.1.7 Hall Farm area has been identified as a potential location for a hospital facility. The waste heat arising from this structure has the potential to be captured and redistributed within the Hall Farm and Four Valleys site through a district heat network approach. This is discussed in Section 6.

2.1.8 Adjacent to and north of Hall Farm (east of the River Loddon) lie additional parcels of farmland that have been promoted for residential development by other landowners and which are being considered as part of the overall site. The UoR's Dairy Research Centre is located to the eastern side of the site (Hall Farm).

2.2 South Wokingham Strategic Development Location (SDL) Extension

2.2.1 The South Wokingham Strategic Development Location (SDL) is a major development to the south of Wokingham town, allocated in the adopted Core Strategy local plan. When completed, in addition to new dwellings, the development will include new primary schools, local shopping and community facilities. Open spaces and roads including a South Wokingham Distributor Road will also be provided.

2.2.2 The majority of the potential extension is land which is not earmarked for residential development within the existing SDL allocation boundary. This area presents an opportunity for a holistic and integrated approach to housing alongside the South Wokingham SDL and could support planned improvements to road and sustainable transport. Approximately 835 residential units could come forward within the South Wokingham SDL Extension site.

3 Policy Context

3.1 National Policy

Climate Change Act 2008

3.1.1 Climate change is recognised as one of the most immediate global environmental challenges. Government legislation now includes numerous provisions designed to minimise climate change and mitigate the anticipated effects.

3.1.2 On 2nd May 2019, the Committee on Climate Change published the Net Zero report, which recommends that the UK Government introduce a target of at least a 100% reduction of greenhouse gas emissions by 2050, known as the Net Zero Target. The Order came into force as an amendment of the Climate Change Act (CCA) 2008 on 27th June 2019[1].The CCA 2008 now mandates that "*the net UK carbon account for the year 2050 is at least 100% lower than the 1990 baseline*."

3.1.3 The UK Government's international commitment (transposed into national and local planning policy) has sought to reduce CO_2 emissions associated with new buildings through energy demand reduction and the incorporation of low and zero carbon technologies to deliver electricity and heat. The national and local policy position is summarised in the following sections.

National Planning Policy Framework 2021

3.1.4 The National Planning Policy Framework (NPPF) (2021) supports the role of the local plan process and maintains the "presumption in favour of sustainable development". Paragraphs 152-158 of the NPPF explain that the planning system should help to: "*shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure*".

3.1.5 Plans should take a proactive approach to mitigating and adapting to climate change and should be planned for in ways that:

- Can help to reduce greenhouse gas emissions, such as through its location, orientation, and design; and
- Provide a positive strategy for renewable and low carbon energy sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily as well as identify suitable areas for renewable and low carbon energy sources, and opportunities for development to draw its energy supply from decentralised, renewable, or low carbon energy supply systems.

3.1.6 When determining planning applications, local planning authorities should expect new development to comply with any development plan policies on local requirements for decentralised energy supply (unless demonstrated to be unfeasible or unviable). Development should also take account of landform, layout, building orientation, massing, and landscaping to minimise energy consumption.

[1] Climate Change Act 2008. London: The Stationery Office, available online at: http://www.legislation.gov.uk/ukpga/2008/27/contents

3.2 National Building Regulations – Part L (Conservation of Fuel and Power)

3.2.1 The UK's international commitments are also transposed into the national Building Regulations. The energy efficiency requirements of the Building Regulations are set out in Part L (Conservation of Fuel and Power). Part L is subject to 'step changes', becoming increasingly stringent as new revisions are adopted.

3.2.2 New developments are encouraged to reduce carbon emissions in accordance with the energy hierarchy of reducing energy demands in the first instance, supplying energy efficiently, and finally the provision of appropriate renewable and low carbon energy technologies.

3.2.1 The current national Building Regulations that define building energy performance are L1A of the Building Regulation 2013, which requires developments to deliver a 6% carbon dioxide saving across the new homes build mix relative to Part L 2010 and introduced a Fabric Energy Efficiency (FEE) target to encourage minimum efficiency for building fabric (the longest lasting part of a home).

3.2.2 Following the Future Homes Standard (FHS) 2019 consultation on Building Regulations Part L (January 2021), it was confirmed that, from 2025, the FHS will deliver homes that are 'zero-carbon ready' by setting a performance standard at a level which requires that new homes will not be built with fossil fuel heating (i.e. natural gas boilers). A proposed uplift of energy efficiency requirements will be implemented in 2021 which will form a "steppingstone" to the FHS, which will be applied from 2025. At this stage, it is expected that the 2021 uplift with comprise a 31% reduction in CO_2 compared to current standards, delivered through a combination of an increase in fabric standards and technology.

3.2.3 Changes in Part L from 2021 are also expected to see a shift to electric-led heating strategies in new developments rather than traditional gas fired plant.

3.2.4 Developments arising within Wokingham will be required to follow new Part L requirements, once adopted.

3.3 Local Policy

3.3.1 In July 2019, WBC declared a climate emergency committing to playing a role in reducing carbon emissions to be net carbon zero by 2030. Following on from this, the Climate Emergency Action Plan was approved in January 2020 laying out the initial steps on the journey to net zero. The Plan sets out WBC's ambitions, including the aspiration to generate more renewable energy in the Borough. This report aims to identify opportunities that support WBC's low carbon ambitions, understand how these strategic developments can perform against existing energy related policy and ultimately supply energy to these growth/emerging developments in a green and low carbon way.

3.3.2 Wokingham Local Plan is a collection of planning documents which currently includes the Core Strategy; Managing Development Delivery Local Plan; Neighbouring Planning. Additional Supplementary Planning Documents (SPDs) provide extra detail in relation to specific policy areas. The current adopted energy-related policies applicable to strategic sites include:

Adopted Core Strategy Development Plan Document (January 2010)

- **Policy CP1 Sustainable Development** - "*Contribute towards the goal of reaching zero-carbon developments by including appropriate on-site renewable energy features and minimising energy consumptions by measures of appropriate layout and orientation, building form, design and construction, and design to take account of microclimate so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form*."

Adopted Managing Development Delivery Local Plan (February 2014)

- **Policy CC04: Sustainable Design and Construction** - *"Planning permission will only be granted for proposals that seek to deliver high quality sustainably designed and constructed developments."*

- **Policy CC05: Renewable Energy and Decentralised Energy Networks** – "*1) Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged; 2) Planning permission will only be granted for proposals that deliver a minimum 10% reduction in carbon emissions through renewable energy or low carbon technology;" 3) Promoting renewable energy and decentralised energy works in line with LA's criteria.*

'Right Homes, Right Places' Draft Local Plan Update (February 2020 – April 2020)

3.3.3 The LPU aims to update the Local Plan and guide where and how growth will take place in the borough in the years up to 2038. A previous draft of the LPU was issued for Reg.18 consultation in early 2020. The energy-related policies and neighbourhood plans applicable to strategic sites that have been considered from the previous draft LPU include:

- **Policy SS3: Grazeley Garden Town** – The Grazeley Garden town is no longer considered deliverable, but the policy approach taken to sustainable development is intended to be taken forward for the replacement strategic allocations
- **Policy SS8: Climate Change**
- **Policy SS9: Adaptation to Climate Change**
- **Policy DH10: Low Carbon and Renewable Generation**
- **Policy DH7: Energy**
- **Policy DH8: Environmental standards for non-residential development**
- **Policy DH9: Environmental standards for residential development**

Arborfield and Barkham Neighbourhood Plan

3.3.4 The Neighbourhood plan is silent in terms of policy in relation to renewable energy. In chapter 3 'Sustainable Development' the Plan refers to unsuccessful large-scale renewable energy schemes such as windfarms and highlights their unpopularity with local residents. They go onto note that it is disappointing that less intrusive solutions have not been forthcoming, such as discreet solar panels.

Shinfield Neighbourhood Plan

3.3.5 The Shinfield Neighbourhood Plan positively encourages the use of renewable and low-carbon or zero carbon technologies (Policy 3: Sustainable Development).

4 Renewable Energy Screening

4.1 Introduction

4.1.1 Stantec has undertaken a renewable energy screening process for both sites. This involved reviewing the suitability of various renewable and low carbon technologies for the two sites. The exercise has considered both a 'multi-plot' level and 'building-specific' level. The variables that have been considered affecting suitability include:

- Environmental constraints (e.g. suitable geology for ground source heat pumps; flood risk; presence of protected ecological species that may be affected by technology);
- Resource constraints (e.g. the availability and reliability of local biomass fuel supplies or the local wind resource);
- Social constraints (e.g. visual or health impacts of placing combustion-based technologies near housing); and
- Infrastructure constraints (e.g. impacts on aviation from wind turbines or the availability of suitable transport infrastructure to import fuel and plant or equipment, grid constraints).

4.2 Renewable Energy Opportunities

4.2.1 Table 4.1 and Table 4.2 below respectively provide a summary of the renewable and low carbon technologies available for Hall Farm/Four Valleys and South Wokingham at this stage. These are supported by 'Energy Opportunities and Constraints' plans included in **Appendix A**.

4.2.2 The options highlighted in green in the tables below are preferred options for further investigation, those in amber have some potential which should be explored once further detail is available, and those in red are considered to be the least appropriate at this stage. Technologies are evolving and costs are changing, therefore the comments given below may be superseded over time.

Table 4.1: Summary of Renewable and Low Carbon Opportunities for Hall Farm & Four Valleys

Technology	Technological risk[2]	Energy availability[3]	Potential contribution (kW / MW)	Suitability	Comment
Air source heat pumps (ASHP)	Low	Baseload	kW - MW	Suitable	ASHP could be installed in suitable buildings to supply a portion of heat demands (as opposed to gas boilers). These are suitable for both residential and commercial buildings. Proposed developments will require an external plant space and the heat plant could be sized to support potential future local heat network. ASHP need to be carefully positioned in a location with accessibility for regular maintenance works. External condensers need careful positioning to avoid visual / noise disturbance. Widespread use throughout the site is only suitable with spare electrical network capacity.
Roof Mounted photovoltaic (PV)	Low	Intermittent	kW - MW	Suitable	Solar PV systems could be installed on suitable south facing roofs of buildings within the site. Large flat roofs are also suitable for this technology and typically can be accommodated in commercial buildings, schools, and community centres. The yearly in-plane irradiation[4][5] for this Site location is 1,212 kWh/m^2. Masterplanning aims to maximise green roofing and therefore there may be limited available roof space to accommodate this technology. Roof mounted PV may be subject to limited roof space as it competes with other uses such as green roof. Large areas of flat roofing exist, and these could be suitable for solar arrays (i.e. Shinfield Studios and the British Museum Site). Stakeholder engagement should be undertaken to ensure the potential for a solar PV system is maximised. This option is supported by tariffs such as the Smart Export Guarantee. It can be a useful 'top-up' carbon savings; however, savings are continuously reducing as the grid decarbonises. On site electricity generation can be used in combination with an active network management (ANM) system.

[2] The Technological risk has been influenced by various factors such as maturity of technology and availability.

3 Base load energy – the amount of energy made available to meet fundamental demands by consumer, typically a constant availability is provided.
Intermittent energy – any source of energy that is not continuously available due to some factor outside direct control (i.e. wind and solar availability).

[4] Yearly in-plane radiation is the power per unit area received from the Sun onto a potential PV module.

[5] European Commission – Photovoltaic Geographical Information System (PVGIS), available online: https://re.jrc.ec.europa.eu/pvg_tools/en/#MR

Technology	Technological risk[2]	Energy availability[3]	Potential contribution (kW / MW)	Suitability	Comment
Ground mounted photovoltaic Solar Panels (PV)	Low	Intermittent	kW - MW	Suitable	There is sufficient open green space within Hall Farm & Four Valleys that could be used for a large-scale (MW) ground mounted PV array. However, it is worth noting there are various competing land uses, limiting the opportunity for this technology mounted on ground. The yearly in-plane irradiation[6] is 1,212 kWh/m^2. This area is subject to high flood risk[7] however, ground mounted PV can be implemented with appropriate technology to manage flood risk. Any ground mounted PV arrays must be considered in the context of any flood alleviation works and proposed Valued Landscape Area and Biodiversity Interest Area identified through the site. It is worth noting that, given the competing land use options (e.g. SANG, playing pitches, etc.) within this area, ground mounted PV may be considered as a 'near site' option, located outside of boundary line. The developments within this site may benefit from connecting to PV array installed in open green spaces in proximity to site.
Solar water heating (or solar thermal)	Low	Intermittent	kW	Suitable	Solar thermal panels could be installed on suitable south facing roof spaces to supply a portion of a buildings' heat demands. These could be situated near hot water cylinders to provide hot water for use within the building or to feed into a connected energy system. This technology could be in conflict with solar PV as there is limited roof space. In most cases solar PV would be preferential over solar thermal technology. This opportunity needs to be further explored in conjunction with other design considerations.
Battery storage and balancing plant (active network management)	Medium/high	Baseload / as required	kW - MW	Suitable	A battery project could reduce peak electrical demands and support an electric led heating approach after 2025, in line with the emerging Building regulations and FHS. A battery project in conjunction with renewable energy generation could help reduce peak electrical demands. However, the technology is currently expensive, and the energy storage markets are largely untested. This risk is likely to diminish over the next five to ten years and engagement with leaders in the market should be undertaken.
Centralised Heat Pumps	Medium/ high	Baseload	kW - MW	Potential to be further explored	Centralised electric air and/ or ground source heat pumps could potentially be suitable for any electric led phases, particularly where/ if higher density development is provided and for non-domestic uses such as a medical centre and care homes. Further investigation is required to confirm whether such an approach would be appropriate

6 European Commission – Photovoltaic Geographical Information System (PVGIS), available online:

[7] Long term flood risk maps https://flood-map-for-planning.service.gov.uk/confirm-location?easting=477137&northing=169413&placeOrPostcode=RG41%205DJ

Technology	Technological risk[2]	Energy availability[3]	Potential contribution (kW / MW)	Suitability	Comment
Water Source Heat Pump (WSHP)	Low/medium	Baseload	kW- MW	Potential to be explored further	River Loddon and tributaries are located in close proximity. This opportunity is discussed further in Section 5.
Ground Source Heat Pumps (GSHP)	Low / medium	Baseload	kW - MW	Potential to be explored further	There may be opportunities to install small-scale systems with horizontal collector loops in localised areas of green open space of the development. A potential piled heat collector approach could be explored. However, due to the geology of the area there may be limitations[8]. The bedrock consists of clay formation, silt and sand at approximately 150m depth[9]. The bedrock comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. Generally, not suitable foundation conditions for GSHP, especially if in weathered areas. There is risk the clay may dry out, shrink away from the pipes, and lose the heat transfer capacity. Further techno-economic appraisal would be required, including detailed appraisal of the thermal conductivity properties of the ground conditions in order to determine whether the geology/bedrock of the area can be used as thermal battery. It is important to determine in situ variability in lithology and properties, including depth and nature of the weathered zone.
Wind Energy	Low	Intermittent	MW	No	The windspeed within this area is estimated to be ranging between 6.1m/s (at 45m height)[10]. This speed is generally suitable for wind turbines. However, it is worth noting some parts of the site are subject to archaeological and cultural heritage constraints. Amongst various listed buildings within the site, there is also a designated (grade II) site situated in close proximity this includes Bearwood College[11]. This historic landscape may also be subject to landscape visual impacts if this technology were to be installed. A wind turbine(s) within the site could potentially cause

[8] The Mineral Resource Maps of Wales - British Geological Survey, available online: http://www.bgs.ac.uk/downloads/start.cfm?id=1665

[9] British Geological Survey, GeoIndex Onshore, available online: https://mapapps2.bgs.ac.uk/geoindex/home.html

[10] RenSmart, available online: https://www.rensmart.com/Maps#NOABL

[11] https://historicengland.org.uk/listing/the-list/map-search?postcode=RG41%205DJ&clearresults=True

Technology	Technological risk[2]	Energy availability[3]	Potential contribution (kW / MW)	Suitability	Comment
					a significant noise, visual and wind-flicker disturbance, which would be detrimental to the amenity of residents and other site users located in close proximity. The spatial analysis (constraints map) demonstrates that there is no portion of land within the site area that could be suitable to accommodate this technology.
Biomass	Low	Baseload	kW - MW	No	The Renewable Heat Incentive (RHI) can reduce the costs of a biomass scheme and provide financial returns. However, the need for regular and large-scale solid wood fuel deliveries via Heavy Goods Vehicles (HGV) make this option undesirable from a traffic generation, exhaust emissions and local air quality perspective (from on-site combustion). The Hall Farm & Four Valleys site is adjacent to the M4 Air Quality Management Area (AQMA)[12]. In addition, very few potential local biomass suppliers are located in close proximity to the site, within 10-mile radius (Biomass Suppliers List[13]). There is a high risk of not being able to potentially secure long-term fuel contracts required for security of supply, which would also need to be tested.
Hydropower	Low	Baseload	kW - MW	No	The River Loddon and tributaries are watercourses identified in the vicinity of the site. However, these are not suitable for generating power for the development due to inappropriate head and flow and no existing suitable weir structure. The river has an average flow of 2.16 m3/s which is not insignificant but with the local typography provides almost no hydrostatic change. Any flood alleviation scheme considered on the river should re-examine the potential for hydropower but from this early assessment a hydropower scheme would be unfeasible.
Gas Combined Heat and Power (CHP) district heating	Low	Baseload	kW-MW	No	Under predicted changes to the Building Regulations in 2020, gas CHP will not achieve the required carbon emission reductions to meet mandatory Part L compliance. Government also has an ambition for homes to be 'gas-free' by 2025. Consideration is given to the viability of district heating using other energy sources in Section 6.
Connection to an offsite district heat scheme	Medium	Baseload	kW - MW	No	There are no known established district heat networks within the immediate vicinity of the Site. Consideration is given to the viability of district heating in Section 6.

[12] Wokingham Borough AQMA Details, available online: https://laqm.defra.gov.uk/images/aqma_maps/285_Wokingham%20M4%20aqma.jpg

[13] GOV.UK, Biomass Suppliers List, available online: https://biomass-suppliers-list.service.gov.uk/Search.aspx?search

Table 4.2: Summary of Renewable and Low Carbon Opportunities for South Wokingham SDL Extension

Technology	Technological risk	Energy availability	Potential contribution (kW / MW)	Suitability	Comment
Air source heat pumps (ASHP)	Low	Baseload	kW - MW	Suitable	ASHP could be installed in suitable buildings to supply a portion of heat demands (as opposed to gas boilers). These are suitable for both residential and commercial buildings. Proposed developments will require an external plant space and the heat plant could be sized to support potential future local heat network. ASHP need to be carefully positioned in a location with accessibility for regular maintenance works. External condensers need careful positioning to avoid visual / noise disturbance. Widespread use throughout the site is only suitable with spare electrical network capacity.
PV on roof of building	Low	Intermittent	kW - MW	Suitable	Solar PV systems could be installed on suitable south facing roofs of buildings within the site. Large flat roofs are also suitable for this technology and typically can be accommodated in commercial buildings, schools, and community centres. The yearly in-plane irradiation[14] for this Site location is 1,212 kWh/m^2. A solar array is located on the roof of Hall Hunter Partnership's (Premium Berry Growers) buildings. This is located south of the development, demonstrating that this technology is feasible within an area. This option is supported by tariffs such as the Smart Export Guarantee. It can be a useful 'top-up' carbon savings; however, savings are continuously reducing as the grid decarbonises. On site electricity generation can be used in combination with an active network management (ANM) system.
Ground mounted photovoltaic Solar Panels (PV)	Low	Intermittent	kW - MW	Suitable	There is sufficient open green space within SDL Extension that could be used for a large-scale (MW) ground mounted PV array. However, it is worth noting there are various competing land uses, limiting the opportunity for this technology mounted on ground. Therefore, 'near site' installation is a potential option where developments within this site may benefit from connecting to an offsite PV array. The yearly in-plane irradiation[15] is 1,212 kWh/m^2, suitable for installing this technology.

14 European Commission – Photovoltaic Geographical Information System (PVGIS), available online: https://re.jrc.ec.europa.eu/pvg_tools/en/#MR

15 European Commission – Photovoltaic Geographical Information System (PVGIS), available online: https://re.jrc.ec.europa.eu/pvg_tools/en/#MR

Technology	Technological risk	Energy availability	Potential contribution (kW / MW)	Suitability	Comment
Solar water heating (or solar thermal)	Low	Intermittent	kW	Suitable	Solar thermal panels could be installed on suitable south facing roof spaces to supply a portion of a buildings' heat demands. These could be situated near hot water cylinders to provide hot water for use within the building or to feed into a connected energy system. This technology could be in conflict with solar PV is there is limited roof space. In most cases solar PV would be preferential over solar thermal technology. This opportunity needs to be further explored in conjunction with other design considerations.
Battery storage and balancing plant (active network management)	Medium/high	Baseload / as required	kW - MW	Suitable	A battery project could reduce peak electrical demands and support an electric led heating approach after 2025, in line with the emerging Building regulations and FHS. A battery project in conjunction with renewable energy generation could help reduce peak electrical demands. However, the technology is currently expensive, and the energy storage markets are largely untested. This risk is likely to diminish over the next five to ten years and engagement with leaders in the market should be undertaken.
Centralised Heat Pumps	Medium/ high	Baseload	kW - MW	Potential to be further explored	Centralised electric air and/ or ground source heat pumps could potentially be suitable for any electric led phases, particularly where/ if higher density development is provided and for non-domestic uses such as the medical centre and care homes. Further investigation is required to confirm whether such an approach would be appropriate.
Ground Source Heat Pumps (GSHP)	Low/medium	Baseload	kW- MW	Potential to be explored further	There may be opportunities to install small-scale systems with horizontal collector loops in localised areas of green open space of the development. A potential piled heat collector approach could be explored. However, due to the geology of the area there may be limitations[16]. The bedrock geology consists of London Clay Formation - Clay, Silt and Sand. Sedimentary Bedrock formed approximately 48 to 56 million years ago in the Paleogene Period[17]. The bedrock comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. Generally, not suitable foundation conditions for GSHP, especially if in weathered areas. There is risk the clay may dry out, shrink away from the pipes, and lose the heat transfer capacity.

[16] The Mineral Resource Maps of Wales - British Geological Survey, available online: http://www.bgs.ac.uk/downloads/start.cfm?id=1665

[17] British Geological Survey, GeoIndex Onshore, available online: https://mapapps2.bgs.ac.uk/geoindex/home.html

Technology	Technological risk	Energy availability	Potential contribution (kW / MW)	Suitability	Comment
					Further techno-economic appraisal would be required, including detailed appraisal of the thermal conductivity properties of the ground conditions in order to determine whether the geology/bedrock of the area can be used as thermal battery. Important to determine in situ variability in lithology and properties, including depth and nature of the weathered zone.
Water Source Heat Pump (WSHP)	Low/medium	Baseload	kW- MW	Potential to be explored further	Emm Brook is located in the southern area of the site. However, this is not suitable due to the extraction rate needed for MW scale. Additionally, water extraction licenses for this waterbody must be secured by requesting approval from the Environment Agency. This process may be time consuming and challenging.
Wind Energy	Low	Intermittent	MW	No	The windspeed within this area is estimated to be around 6.1m/s (at 45m height)[18]. This speed is generally suitable for wind turbines. However, it is worth noting that within the site there are designated (grade II) sites including The Garden House[19]. This historic landscape may also be subject to landscape visual impacts if this technology were to be installed. A wind turbine(s) within the site could potentially cause a significant noise, visual and wind-flicker disturbance, which would be detrimental to the amenity of residents and other site users located in close proximity. The spatial analysis (constraints map) demonstrates that there is no portion of land within the site are that could be suitable to accommodate this technology.
Biomass	Low	Baseload	kW - MW	No	The Renewable Heat Incentive (RHI) can reduce the costs of a biomass scheme and provide financial returns. However, the need for regular and large-scale solid wood fuel deliveries via Heavy Goods Vehicles (HGV) make this option undesirable from a traffic generation, exhaust emissions and local air quality perspective (from on-site combustion). In addition, very few potential local biomass suppliers are located in close proximity to the site, within 10-mile radius (Biomass Suppliers List[20]). There is a high risk of not being able to potentially secure long term fuel contracts required for security of supply, which would also need to be tested.

[18] RenSmart, available online: https://www.rensmart.com/Maps#NOABL

[19] https://historicengland.org.uk/listing/the-list/list-entry/1118079

[20] GOV.UK, Biomass Suppliers List, available online: https://biomass-suppliers-list.service.gov.uk/Search.aspx?search

Technology	Technological risk	Energy availability	Potential contribution (kW / MW)	Suitability	Comment
Hydropower	Low	Baseload	kW - MW	No	Emm Brook is the only watercourse identified, located on the southern part of the Site. However, this is not suitable for generating power for the development (inappropriate head and flow and no suitable weir structure).
Gas Combined Heat and Power (CHP) district heating	Low	Baseload	kW-MW	No	Under predicted changes to the Building Regulations in 2020, gas CHP will not achieve the required carbon emission reductions to meet mandatory Part L compliance. Government also has an ambition for homes to be 'gas-free' by 2025. Consideration is given to the viability of district heating using other energy sources in Section 6.
Connection to an offsite district heat scheme	Medium	Baseload	kW - MW	No	There are no known established district heat networks within the immediate vicinity of the Site. Consideration is given to the viability of district heating in Section 6.

4.3 Summary of Findings

4.3.1 Overall, ASHPs, solar water heating, ground-mounted and roof-mounted PVs have been the renewable energy technologies identified as most suitable for both sites. In addition, a battery storage and balancing plant is also considered to be a technology that can provide an opportunity to support an active network management.

4.3.2 Centralised electric heat pumps are potentially suitable for developments that want to pursue an electric led heating strategy. There is opportunity to introduce a heat network with central air source heat pumps (ASHPs) (typically located at roof level) and local water source heat pumps (WSHPs) located within dwellings (an ambient loop communal heat network, akin to a fifth generation, 5G, heat network). This technology is appropriate for both residential and non-residential buildings and is suitable for higher density developments and/or non-domestic uses such as medical centre and care homes).

4.3.3 GSHPs are a potential technology that is subject to further exploration as it is highly dependent on a suitable geology bedrock condition. It is worth also noting this technology entails a high initial capital investment upfront.

4.3.4 The land suitability plans, illustrated in **Appendix A**, show the land suitability information specifically for PV sites (i.e. slope under 35degrees, and south-facing land). These provide a bivariate plan showing the areas that are unsuitable/constrained (in red) and suitable/unconstrained (in green) for PV development.

5 Heat Network Opportunities

5.1 Heat Network History and Background

5.1.1 Heat networks have existed in many forms for centuries when early pioneers realised the potential of tapping into abutment energy sources and distributing their heat to various locations. Heat networks as we know today originated around 150 years ago when cities like Hamburg and Manhattan installed what are typically coined first generation district heat networks that conveyed high temperature steam through concrete ducts.

5.1.2 Second generation systems, which were used from the 1930's to 1970's, used pressurised hot water at around 100°C leading to improved efficiency. Third generation systems developed towards the end of the 1970's was the first generation of system that was widely adopted, particularly by the Scandinavian countries. They use prefabricated, insulated pipes which usually operate below 100°C. They use a wider range of energy sources such as biomass, waste energy and solar.

5.1.3 Fourth generation networks are based on reduced temperature networks of around 60°C and are most suitable where high-density developments or heavy energy anchors are present, such as commercial uses (i.e. hospitals). This form of heat network can reduce the losses as well as being more suitable for contribution from renewable energy and heat transport. These systems use a wider range of energy sources often in parallel.

5.1.4 A 5th generation district heat network, often referred to as an ambient loop communal heat network, is generally an electric led-communal heating system. The technology that underpins this generation can be used at a building or development level and are often suitable for high density residential developments. Brands include Glen Dimplex and the Kensa Group, but other similar systems are available.

5.1.5 Typically, these systems consist of in-apartment heat pumps connected to a refrigerant free communal energy loop. A centralised low temperature heat store keeps this water loop maintained at a regulated temperature (circa 25°C). Such systems have the capacity to provide future connection to a district heat network. An integral unit is provided within each building unit (e.g. within each apartment) which contains the heat pump technology and a hot water cylinder. The heat pump can be specified to provide heating only or heating and cooling.

5.2 Heat Network Opportunities

5.2.1 Both fourth and fifth generation district heat networks are still suitable for use in certain situations, depending on the local parameters. Fourth generation district heat networks work best with higher density developments and where opportunities for heat generation are readily available as waste or from sustainable sources (i.e. hospitals). Fifth generation heating networks can work across a variety of densities but are more constrained by the site and its features, such as the geology, solar and nature energy sources such as water bodies.

5.3 Fourth generation

5.3.1 The initial housing densities and employment types across Hall Farm/Four valley and South Wokingham are not of high density and therefore the viability of any scheme is instantly negatively impacted. Opportunities may arise in presence of heavy energy anchors such as commercial uses (i.e. hospitals). Wokingham Borough Council should engage with local stakeholders to seek out opportunities from industrial surpluses from manufacturing or data centres. Biogas opportunities could also be explored, engagement with local stakeholders and biogas providers should be undertaken. Biogas should only be considered if the supply is sustainable through the entirety of the supply chain.

5.3.2 One of the initial opportunities identified was to explore how heat could be captured and redistributed from any potential hospitals on the Hall Farm/Four Valleys site. Historically speaking, **hospitals have required high** energy demand and **therefore have** been associated with high losses. However, new hospitals have to obtain the same building regulations as all other buildings, therefore the opportunity for waste heat will be significantly lower in the future.

5.3.3 Where waste heat is still generated on a hospital site it will feed into the hospital's own energy centre and this waste heat can form part of a closed loop sustainable energy system at the hospital.

5.4 Fifth generation

5.4.1 Fifth generation district heating networks work across a range of densities and scale and are non-traditional shape with decentralised heat pumps supply heat along low temperature networks. The lower supply temperature means un-insulated plastic pipework is suitable, meaning significant costs and labour reductions. One of the benefits of fifth generation loops is they provide a single integrated plug-and-play heating and cooling system, ultimately giving the flexibility in timings for developers.

5.4.2 It is also estimated that fifth generation heat networks provide an additional carbon reduction over local air source heat pumps by offering in a perfect system 25% further reductions in CO2. It must be noted however that this goes well beyond the reduction required through building regulation changes.

5.4.3 The key to delivering efficient fifth generation heat networks is to ensure a suitable energy store is available. Detailed ground investigation is required to understand the opportunity for utilising local aquifers or bodies of water. Both sites are in close proximity to natural water supplies and any flood alleviation schemes provided within the Hall Farm and Four Valleys site offers a unique opportunity to develop a flood alleviation strategy with the potential for infrastructure for a heating network to be incorporated.

5.5 Heat Network Site Review

Table 5.1: Heat Network Suitability

	Density Suitability	Low Carbon Heating Opportunities	Natural energy store
Four Generation District Heat Network	Unlikely to be suitable for low density development due to cost of infrastructure	Fourth generation networks will only provide suitably low carbon heating when sourced through a waste or low carbon source	Fourth generation loops have greater running temperatures and therefore nature energy stores are not suitable.
Fifth Generation District Heat Network	Suitable for an array of densities	Fifth generation loops do not need high temperature heat typically provided through waste heat opportunities and therefore greater opportunities exist for renewable energy systems to be deployed	Fifth generation networks rely on consistent ambient temperatures and therefore work best with high quality natural (aquifers, lakes) or manmade (wells, canals) energy stores.

Table 5.2: Site Assessment

	Proposed Density	Waste Heat/ Low Carbon Heat Opportunities	Natural energy store	Suitability
Hall Farm and Four Valleys	Low Density Housing & Low-Density Employment Currently Proposed	No local strategic waste heat opportunities have been identified but engagement could be undertaken to identify potential sources	The flood alleviation scheme could provide an opportunity to use a significant body of water as an energy store. Ground investigation should be undertaken to identify the potential of using as an aquifer as a potential energy source.	Potential for Fifth Generation District Heat Networks to be explored in greater detail.
South Wokingham SDL Extension	Low Density Housing & Low-Density Employment Currently Proposed	No local strategic waste heat opportunities have been identified but engagement could be undertaken to identify potential sources	Ground investigation should be undertaken to identify the potential of using as an aquifer as a potential energy source.	Unlikely to be suitable for District Heating but further ground investigation should consider underlying geology and its suitability for bore hole heat loops.

5.5.1 The Site and Heat Network Generation review undertaken in Table 5.1 and Table 5.2 has identified that the viability of a fourth -generation district heat network at either site is unlikely to be suitable.

5.5.2 The potential for fifth generation loops should be explored further, firstly by understanding the underlying geology at both sites. The Hall Farm and Four Valleys site has the greatest potential for fifth generation district heating due to the potential opportunity available through any flood attenuation scheme, however the impact on the local water network and ecology will require a detailed and complex assessment made more difficult by the lack of experience in delivering fifth generation networks in the UK.

5.5.3 One of the benefits of the fifth-generation heat networks is the plug and play element which suits land developers, however the carbon reduction over other low carbon technologies, such as air source heats are predicted to be marginal and will become more marginal over time as the grid becomes further decarbonised. Therefore, the justification on the grounds of reduced emissions is a weak one as both systems meet current emissions regulations and will decarbonise at a similar rate.

5.5.4 The potential use of fifth generation district heat networks should only be made on the grounds of a solid financial case and assuming that any impacts to the local ecology is managed and mitigated.

6 Utilities and Grid Infrastructure

6.1.1 A network of overhead and underground cables routes serves the existing properties on the site. Some of this infrastructure may need to be diverted to accommodate the new development. There are SSE LV cables associated with the existing dwellings located within the study area and the surrounding residential developments.

6.1.2 It is anticipated that, as the climate change agenda grows, there will be a strong drive towards the electrification of transport and heating systems. This is already supported by the emerging Building Regulations and Future Homes Standards (January 2021)[21] that promote the deployment of electric-led heating systems (i.e. ASHPs) in new developments and put an end to fossil-fuel systems (i.e. gas-fired boilers). In addition, the Government published several proposals to alter the Building Regulations to include EV infrastructure requirements[22, 23]. For new residential buildings, the Government proposes "*a requirement of a charge point in every new home with an associated parking space… the charge points must have a minimum power rating output of 7kW*".

6.1.3 The rise of electric-led developments and EV infrastructure will foster new challenges to the power grid. The introduction of electric-powered technologies will imply additional high electrical loads that the current power network may not be able to accommodate. It is likely that such loads may exceed local electrical capacity and therefore, reinforcement costs may be required to secure sufficient capacity for these sites.

6.1.4 The SSE Generation Availability Mapping[24] indicates that there are two substations operated by Scottish & Southern Electricity Networks (SSEN) located in proximity to the sites. Table 6.1 provides substation details below. Both substations are unconstrained and would be able to accommodate upcoming developments in the area without the need of reinforcement costs. Sufficient headroom capacity within the Wokingham BSP would be able to accommodate additional renewable and low carbon technologies. Further liaison with SSEN is recommended as the development of these schemes progress.

Table 6.1: Generation availability and substation capacity May 2021

Substation Type	Reference Name	Upstream/Down stream Status	Location from Site
Bulk Supply Point (BSP)	Wokingham	Unconstrained	Location (Lat, Long): 51.402423, -0.857213 East of Hall Farm & Four Valleys site (circa 5km) and West of South Wokingham SDL Extension site (circa 2km
Primary Substation	Elms Road	Unconstrained	Location (Lat, Long): 51.410192, -0.836185 East of Hall Farm & Four Valleys site (circa 6km) and North of South

[21] The Future Homes Standard: 2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings (January 2021), available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/956094/Government_response_to_Future_Homes_Standard_consultation.pdf

[22] Electric Vehicle Charging in Residential and Non-Residential Buildings (July 2019) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/818810/electric-vehicle-charging-in-residential-and-non-residential

[23] Minimum Technical Specification – Electric Vehicle Homecharge Scheme (EVHS) (March 2020) https://www.gov.uk/government/publications/electric-vehicle-homecharge-scheme-minimum-technical-specification/electric-vehicle-homecharge-scheme-minimum-technical-specification

24 https://www.ssen.co.uk/GenerationAvailabilityMap/?mapareaid=1

			Wokingham SDL Extension site (circa 1km)
Primary Substation	Arborfield	Upstream Unconstrained	Location (Lat, Long): 51.398309, -0.909654 South of Hall Farm & Four Valleys site (circa 1.5km) and West of South Wokingham SDL Extension site (circa 7km)
Primary Substation	Little Hungerford	Unconstrained	Location (Lat, Long): 51.441541, -0.917258 North of Hall Farm & Four Valleys site (circa 3.5km

6.1.5 Despite the presence of unconstrained electrical utility points located in vicinity to the sites, it is anticipated that the current capacity would not be sufficient to accommodate the potential EV chargers, residential (approximately 4,500 units at Hall Farm; 835 at South Wokingham SDL Extension) and commercial developments (film studios, retail, hospital) that may arise within this area. This is due to the considerable new electrical loads required for decarbonisation of heat and transport. This implies that reinforcement / upgrade works may be required to support future developments at these sites, and therefore further liaison with SSEN should be sought.

6.2 Smart Energy Infrastructure

6.2.1 In addition to peak loads arising from EV charging, further challenges on the energy system are anticipated including the change in energy demands arising from Covid-19 pandemic, the shift of ‘smart working’ and social distancing. To address this challenge, there may be an opportunity to develop and deliver an integrated and ‘smart’ energy approach.

6.2.2 Potential smart solutions include the incorporation of emerging technologies to actively manage the generation and use of energy. ‘Smart’ in this context relates to the use of data and the incorporation of information and communication technologies to deliver improved operational outcomes.

6.2.3 Given the potential for decentralised energy generation at both sites, it could be possible to develop a distributed energy resource (DER) strategy across the scheme. This would connect the power generation distributed across the project with the development’s energy demand through network controls (turning power and demand on and off accordingly). This approach is driven by demand management in the first instance and followed by energy generation to support the management of demand.

6.2.4 It is estimated that National Grid electricity will have lower associated carbon emissions than gas by 2025. This will therefore need to be considered when appraising the amount and types of on-site low/zero carbon energy technologies for the site in the context of carbon management and reduction.

6.2.5 DER is an energy system that links up several smaller, decentralised energy generation schemes and controls them via a central control system (remotely). This turns this decentralised energy into a Virtual Power Plant (VPP) for the scheme. A VPP is a system that integrates several types of power sources, (such as PV) to give a more reliable overall power supply. The advantage of integrating these technologies with control mechanisms and potentially back-up storage systems is so that these technical interventions reduce the reliance on the distribution network for peak supply. In return this reduces the need for potential offsite grid reinforcements which can require early capital outlay.

6.2.6 If this option is to be considered further, a more detailed technical and commercial appraisal will be required including engagement with the Distribution Network Operator (DNO) (SSEN), or an Independent DNO (IDNO), to see whether this option would be accepted.

6.2.7 In addition, there could also be opportunities to incorporate ‘smart’ technologies within homes or within the local power infrastructure. There are opportunities to digitalise the energy assets in order optimise energy use and generation. Through ‘smart technologies it is possible to manage the of settlement Import/Export metering from micro-generation sites, providing generation analytics, EV scheduling and/or FiT metering to measure the total generation in accordance with industry standards.

6.2.8 Additional opportunities could include incorporating ‘building-specific’ energy monitoring technologies, allowing occupants to have greater interaction with their resource consumption through ‘smart’ web-based applications. Smart meters involve next-generation electricity meters which send regular meter readings to the energy supplier automatically. Smart meters record detailed energy consumption and share this data with customers in order to allow control of their energy consumption. This allows more accurate bills based on actual energy usage information as opposed to being based on estimates.

6.2.9 In addition, smart meters also help visualise consumers’ energy use through the use of an in-home display (IHD), a digital screen providing live information. This type of technology helps consumers monitor their energy use in both kilowatt hours (kWh), and in pounds and pence, incentivising behavioural change to a more sustainable one. The aim is to support energy users to lower energy costs and improve their carbon impact. To explore these options going forward, the council and developers should look to collaborate with local or national organisations active in this market.

7 Conclusions

7.1.1 Section 4.63 of Policy SS8 of the 2020 Draft WBC Local Plan states *"It is essential that development proposals utilise every opportunity to reduce carbon emissions now to limit the extent of future climate change. Our priority is to minimise the need to travel by private car and to improve the energy efficiency of buildings. This reflects the two largest areas of carbon emissions for the borough."* This demonstrates the intention of prioritising energy efficiency in buildings through design. This report recommends the investment in passive and active measures to reduce energy demand in buildings.

7.1.2 A range of renewable energy technologies are potentially suitable for use across Hall Farm/Four Valleys and South Wokingham. Primary emphasis should be given to electric-led solutions such as ASHPs, EVs and PV arrays. The majority of these technologies are possible for development building at scale. This removes up-front costs and ultimately improves the viability of the systems. Engagement with key stakeholders should be undertaken to identify how these technologies can be adopted by developments and set out potential expectations from a planning submission.

7.1.3 On a strategic scale, several opportunities should continue to be explored with stakeholders. The first of these is how large-scale renewable systems can be integrated as part of any proposed valued landscape area or flood alleviation works on the Hall Farm/Four Valleys site.

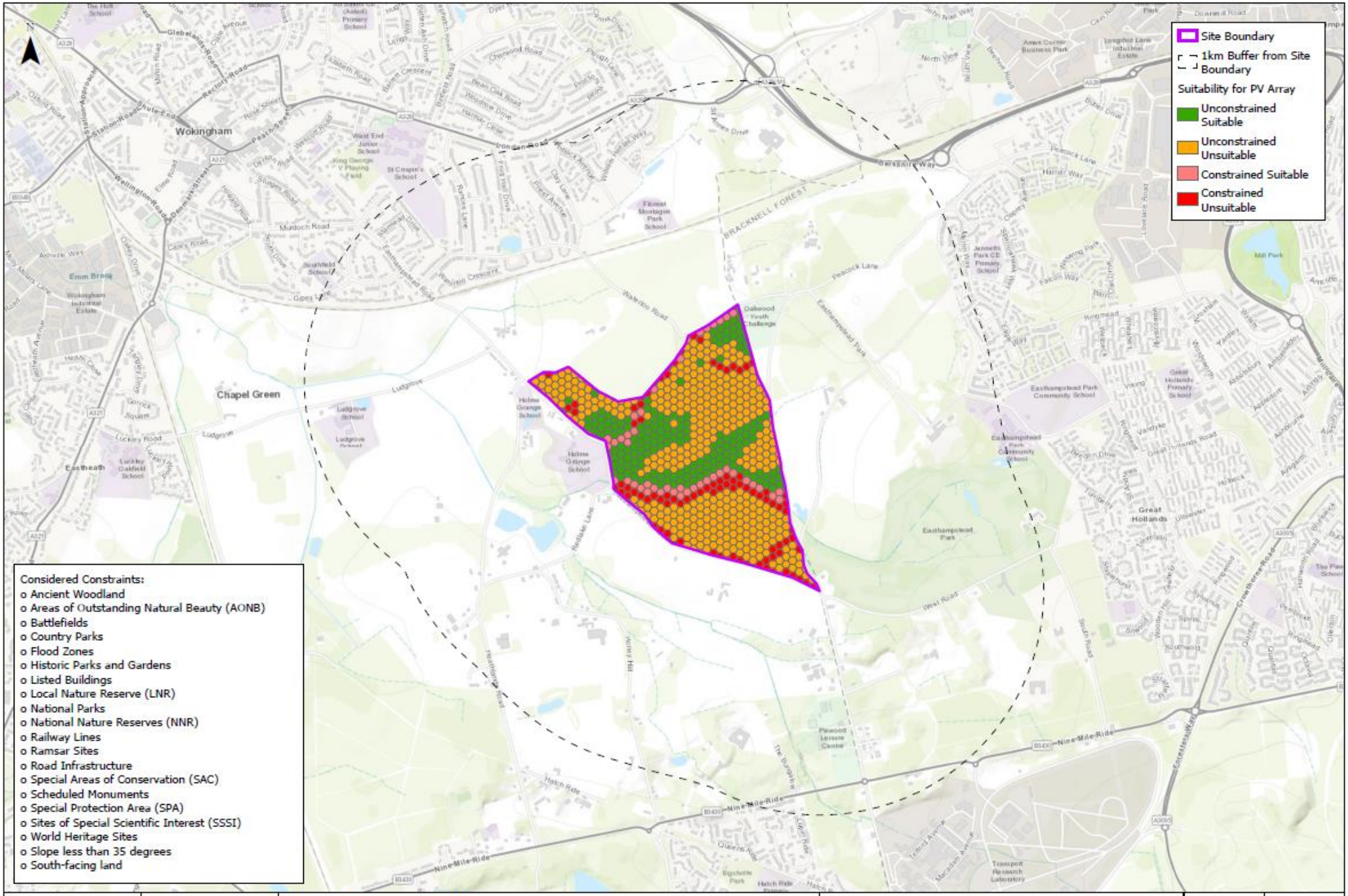
7.1.4 Secondly, the suitability of battery storage, balancing technologies, and active network management systems. Further engagement should be undertaken with SSE to understand the local grid and how balancing opportunities can increase the resilience of the local system. This should also consider any strategic energy scheme that is potentially put forward on the Hall Farm/Four Valleys site.

7.1.5 Unconstrained electrical utilities have been identified in vicinity to the sites. However, reinforcements costs and upgrade works are anticipated, as potential EV chargers, residential (approximately 4,500 units at Hall Farm; 835 at SDL Extension) and commercial developments (film studios, retail, hospital) may come forward within this area. Further liaison with SSEN is recommended on this matter.

7.1.6 Overall, there are clear tangible opportunities within the two sites of focus. The renewable and low carbon opportunities identified within this report would have the potential to meet local planning policy and go above and beyond compliance. This would support WBC's ambitions in tackling climate change and contribute towards a transition to a net zero future. A summary of recommendations is listed below:

- Prioritise passive and active energy efficiency measures within the masterplanning of developments;
- Implement non-fossil fuel heating solutions to support the decarbonisation of future buildings (both residential and commercial);
- Support the introduction of heat networks to optimise the heat use within the site areas, particularly focused at heavy energy anchors where commercially viable (e.g. hospital, film studios);
- Encourage the introduction of renewable energy generation technologies including solar PVs; and
- Forward fund smart energy infrastructure and active network management systems and digitalisation of energy assets.

Appendix A Land Constraint Plan for PV



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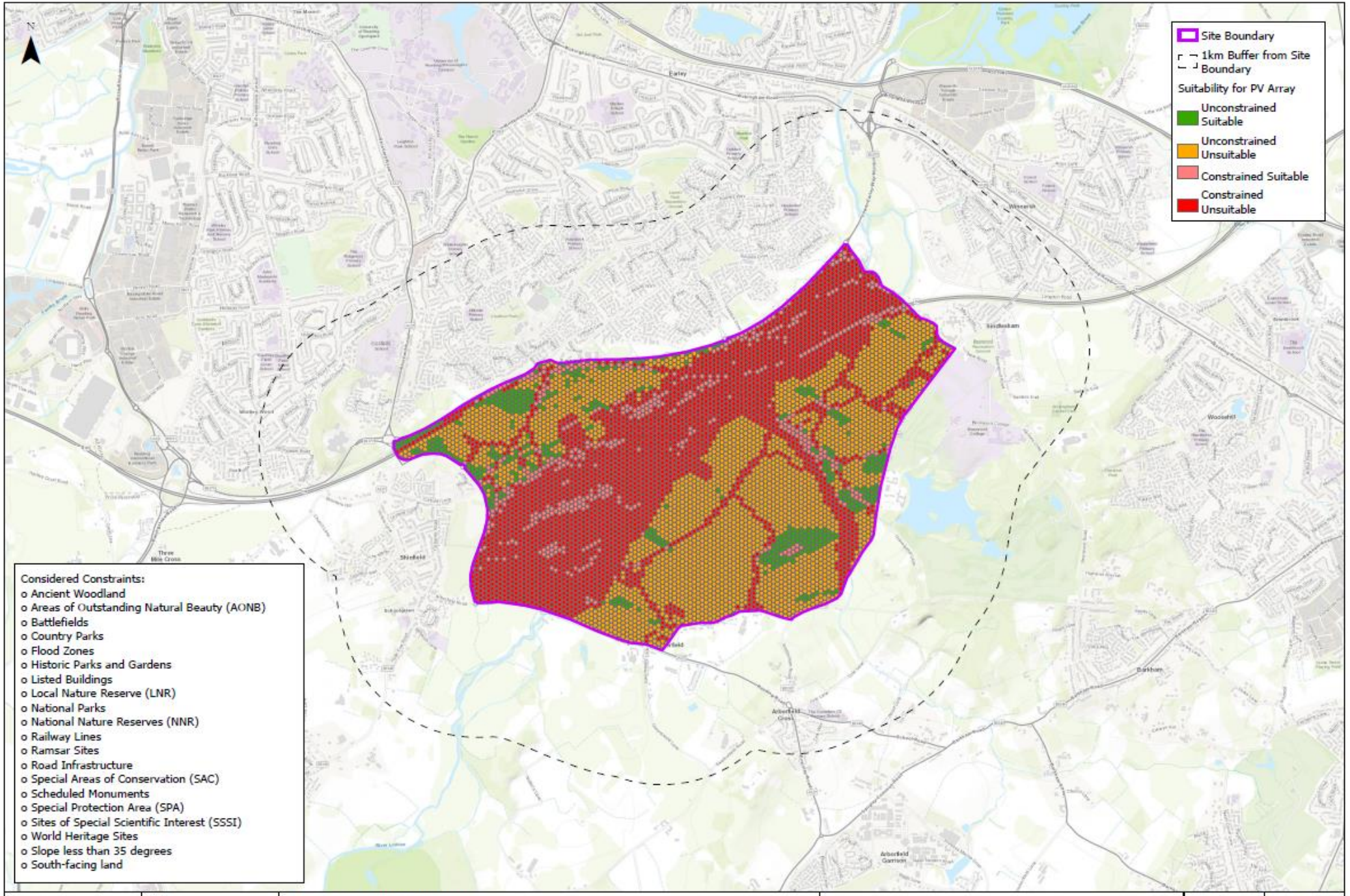

Stantec

Client: Wokingham Borough Council

WBC LOCAL PLAN UPDATE

Renewable Technologies Screening - Land Suitability for Potential Photovoltaic Array Sites - Hall Farm & Four Valleys

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